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Benefits of a Balance Exercise Assist Robot in the Cardiac Rehabilitation of Older Adults with Cardiovascular Disease

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Introduction

As people get older, the number of people who suffer from cardiovascular disease (CVD) rises. Reduced exercise ability, diminished physical and cognitive abilities and depression are common comorbidities in older persons with CVD. They also typically suffer from issues that are common among older persons, like as frailty and sarcopenia. Physical, social and cognitive/depression elements of frailty all play a role in both cardiovascular and non-cardiovascular mortality. The life expectancy of elderly persons with CV is reduced due to a variety of issues.

There are few data on how patients with CVD can maintain their equilibrium. Skeletal muscular problems are common in these patients and they often have poor balance. In addition, frailty and sarcopenia together enhance the chance of falling. Patients with heart failure, in particular, are at a higher risk of femoral fracture after a fall. As a result, both community-dwelling older persons and those with CVD should focus on improving balance and reducing falls. Measures to improve CVD patients' balance capacity and lower their risk of falling are essential in this scenario. Fall prevention can be achieved by exercise therapy, which includes balancing exercises [1].

Patients who were at least 65 years old and had been hospitalised for worsening CVD between August 2019 and December 2021 (Department of Cardiology, National Center for Geriatrics and Gerontology, Obu, Japan) were included in this prospective interventional trial. Participants completed questionnaires such as the Fall Efficacy Scale-International (FES-I), Geriatric Depression Scale (GDS) and Mini Nutritional Assessment-Short Form, as well as a cardiopulmonary exercise test, laboratory measures, echocardiography and a physical function evaluation (MNA-SF). The European Association of Cardiovascular Imaging's current criteria were followed while obtaining standard echocardiographic readings [2].

Four senior sonographers who are members of the Japan Society of Ultrasonics in Medicine and registered medical sonographers completed all of the echocardiographic examinations. The left lateral decubitus or supine positions were used for transthoracic echocardiograms. Vivid 7 (GE Healthcare, Wauwatosa, WI, USA) or iE33 (Philips Healthcare, Eindhoven, The Netherlands) software was used to perform M-mode, 2-dimensional, pulsed and colour tissue Doppler echocardiography on all patients utilising a phased-array electronic ultrasound equipment. According to the modified Simpson's approach, the left ventricular ejection fraction was calculated [3]. From the pulsed Doppler echocardiography data, the peak flow velocities at the mitral level during rapid filling (E) and atrial contraction (A), the E/A ratio and the deceleration time were computed.

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The early diastolic filling velocity (E') was calculated using the tissue Doppler imaging wave of the mitral annulus captured from the septal side of the apical 4-chamber image. The operators who performed the echocardiographic examinations were unaware of the patients' medical condition. After the patients had been medically stabilised, these assessments were done immediately before discharge. Structural heart disease (angina pectoris or myocardial infarction, with a history of revascularization procedures); symptomatic heart failure (non-ischemic cardiomyopathy, ischemia, tachycardia, bradycardia, valvular, or hypertension); and others were among the inclusion criteria [4].

In the absence of coronary artery disease, valvular, pericardial, or congenital heart disease, non-ischemic cardiomyopathies were classified as ventricular myocardial anomalies. Atrial, supraventricular and ventricular arrhythmias; sick sinus syndrome; and atrioventricular block in the absence of structural cardiac disease were all examples of tachycardia and bradycardia. According to the American College of Cardiology-American Heart Association recommendation, valvular heart disease was diagnosed based on hemodynamic or echocardiographic evidence or a history of valvular or congenital cardiac surgery. A systolic blood pressure of 140 mmHg, a diastolic blood pressure of 90 mmHg, or a history of hypertension therapy was all considered hypertension.

Severe respiratory dysfunction (i.e., patients on long-term oxygen therapy for respiratory disease), liver dysfunction (Child–Pugh score class C), stroke, renal dysfunction (reduced glomerular filtration rate and albuminuria category G5), malignant tumours with a prognosis of less than 1 year and criteria corresponding to the CR contraindications in the Japanese Circulation Society Guidelines for Rehabilitation in Patients with Cardiovascular Disease The study procedure followed the Declaration of Helsinki and each individual gave written informed permission. The study was approved by Nagoya University's Ethics Review Board (approval no. 2020).

We did a prospective trial in 52 persons who were referred to our hospital for deteriorating CVD to see if adding a recently created gadget, the BEAR, to CR improves the balancing capacity of older adults with CVD. Participants utilised a BEAR for balance exercises and an ergometer for cardiovascular activities once a week for four months after discharge. In older persons with CVD, we discovered that a BEAR-assisted CR intervention increased gait speed, SPPB score, TUG time and knee extension, but not peak VO2 or FES-I. Furthermore, no adverse events such as fatal arrhythmia, syncope, worsening heart failure, or acute coronary syndrome occurred while individuals conducted BEAR exercises; one person quit because to knee pain [5].

Several robotic aid systems have been shown to be useful in exercise treatment. Patients with heart failure increased their exercise abilities and quality of life by using a robotic walking support device. In patients with heart failure, an exoskeleton-style robot was shown to be safe to use and the individuals expressed a strong desire to utilise it. Our current study is the first to report on exercise therapy for older persons with CVD employing a BEAR in CR protocols, to our knowledge. Our current study is the first attempt to incorporate a BEAR into a CR intervention for CVD patients who we believe might benefit from learning posture adjustments through BEAR exercises

Conclusion

In older persons with CVD, CR combined with BEAR exercises improved physical function, especially balance. Despite the small sample size, robust

participants exhibited no improvements, whereas frail or prefrail subjects improved in several metrics. Randomized controlled trials and follow-up surveys should be conducted to confirm the impact of CR, including BEAR exercises, on these patients' prognoses.

Conflict of Interest

None.

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